

there must be means to indicate contamination before it reaches the capacity established in accordance with paragraph (b)(3) of this section.

(5) Any filter bypass must be designed and constructed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that the collected contaminants are not in the bypass flow path.

(6) Each strainer or filter required by this paragraph that has no bypass, except the strainer or filter at an oil tank outlet or for a scavenge pump, must have provisions for connection with a warning means to warn the pilot of the occurrence of contamination of the screen before it reaches the capacity established in accordance with paragraph (b)(3) of this section.

(7) Each strainer or filter required by this paragraph must be accessible for draining and cleaning.

(c) *Oil tanks.* (1) Each oil tank must have an expansion space of not less than 10 percent of the tank capacity.

(2) It must be impossible to inadvertently fill the oil tank expansion space.

(3) Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have provision for fitting a drain.

(4) Each oil tank cap must provide an oil-tight seal. For an applicant seeking eligibility for an engine to be installed on an airplane approved for ETOPS, the oil tank must be designed to prevent a hazardous loss of oil due to an incorrectly installed oil tank cap.

(5) Each oil tank filler must be marked with the word "oil."

(6) Each oil tank must be vented from the top part of the expansion space, with the vent so arranged that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.

(7) There must be means to prevent entrance into the oil tank or into any oil tank outlet, of any object that might obstruct the flow of oil through the system.

(8) There must be a shutoff valve at the outlet of each oil tank, unless the external portion of the oil system (including oil tank supports) is fireproof.

(9) Each unpressurized oil tank may not leak when subjected to a maximum

operating temperature and an internal pressure of 5 p.s.i., and each pressurized oil tank must meet the requirements of § 33.64.

(10) Leaked or spilled oil may not accumulate between the tank and the remainder of the engine.

(11) Each oil tank must have an oil quantity indicator or provisions for one.

(12) If the propeller feathering system depends on engine oil—

(i) There must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself;

(ii) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump; and

(iii) Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.

(d) *Oil drains.* A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

(1) Be accessible; and

(2) Have manual or automatic means for positive locking in the closed position.

(e) *Oil radiators.* Each oil radiator must withstand, without failure, any vibration, inertia, and oil pressure load to which it is subjected during the block tests.

[Amdt. 33-6, 39 FR 35466, Oct. 1, 1974, as amended by Amdt. 33-10, 49 FR 6852, Feb. 23, 1984; Amdt. 33-21, 72 FR 1877, Jan. 16, 2007; Amdt. 33-27, 73 FR 55437, Sept. 25, 2008; Amdt. 33-27, 73 FR 57235, Oct. 2, 2008]

#### § 33.72 Hydraulic actuating systems.

Each hydraulic actuating system must function properly under all conditions in which the engine is expected to operate. Each filter or screen must be accessible for servicing and each tank must meet the design criteria of § 33.71.

[Amdt. 33-6, 39 FR 35467, Oct. 1, 1974]

#### § 33.73 Power or thrust response.

The design and construction of the engine must enable an increase—

(a) From minimum to rated takeoff power or thrust with the maximum bleed air and power extraction to be

permitted in an aircraft, without over-temperature, surge, stall, or other detrimental factors occurring to the engine whenever the power control lever is moved from the minimum to the maximum position in not more than 1 second, except that the Administrator may allow additional time increments for different regimes of control operation requiring control scheduling; and

(b) From the fixed minimum flight idle power lever position when provided, or if not provided, from not more than 15 percent of the rated takeoff power or thrust available to 95 percent rated takeoff power or thrust in not over 5 seconds. The 5-second power or thrust response must occur from a stabilized static condition using only the bleed air and accessories loads necessary to run the engine. This takeoff rating is specified by the applicant and need not include thrust augmentation.

[Amdt. 33-1, 36 FR 5493, Mar. 24, 1971]

#### § 33.74 Continued rotation.

If any of the engine main rotating systems continue to rotate after the engine is shutdown for any reason while in flight, and if means to prevent that continued rotation are not provided, then any continued rotation during the maximum period of flight, and in the flight conditions expected to occur with that engine inoperative, may not result in any condition described in § 33.75(g)(2)(i) through (vi) of this part.

[Amdt. 33-24, 72 FR 50867, Sept. 4, 2007]

#### § 33.75 Safety analysis.

(a) (1) The applicant must analyze the engine, including the control system, to assess the likely consequences of all failures that can reasonably be expected to occur. This analysis will take into account, if applicable:

(i) Aircraft-level devices and procedures assumed to be associated with a typical installation. Such assumptions must be stated in the analysis.

(ii) Consequential secondary failures and latent failures.

(iii) Multiple failures referred to in paragraph (d) of this section or that result in the hazardous engine effects defined in paragraph (g)(2) of this section.

(2) The applicant must summarize those failures that could result in major engine effects or hazardous engine effects, as defined in paragraph (g) of this section, and estimate the probability of occurrence of those effects. Any engine part the failure of which could reasonably result in a hazardous engine effect must be clearly identified in this summary.

(3) The applicant must show that hazardous engine effects are predicted to occur at a rate not in excess of that defined as extremely remote (probability range of  $10^{-7}$  to  $10^{-9}$  per engine flight hour). Since the estimated probability for individual failures may be insufficiently precise to enable the applicant to assess the total rate for hazardous engine effects, compliance may be shown by demonstrating that the probability of a hazardous engine effect arising from an individual failure can be predicted to be not greater than  $10^{-8}$  per engine flight hour. In dealing with probabilities of this low order of magnitude, absolute proof is not possible, and compliance may be shown by reliance on engineering judgment and previous experience combined with sound design and test philosophies.

(4) The applicant must show that major engine effects are predicted to occur at a rate not in excess of that defined as remote (probability range of  $10^{-5}$  to  $10^{-7}$  per engine flight hour).

(b) The FAA may require that any assumption as to the effects of failures and likely combination of failures be verified by test.

(c) The primary failure of certain single elements cannot be sensibly estimated in numerical terms. If the failure of such elements is likely to result in hazardous engine effects, then compliance may be shown by reliance on the prescribed integrity requirements of §§ 33.15, 33.27, and 33.70 as applicable. These instances must be stated in the safety analysis.

(d) If reliance is placed on a safety system to prevent a failure from progressing to hazardous engine effects, the possibility of a safety system failure in combination with a basic engine failure must be included in the analysis. Such a safety system may include safety devices, instrumentation, early warning devices, maintenance checks,